MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY.

VOL. XXIII. *November* 14, 1862. No. 1.

Dr. LEE, President, in the Chair.

Lieut. Bailey, R.N., H.M.S. Excellent;
Lieut. H. Morland, Ebury Street, Pimlico; and
David Hornby, Esq., 46 Guildford Street,

were balloted for and duly elected Fellows of the Society.

Letter from Prof. Grant to the Editor.

I send you herewith, for insertion in the *Monthly Notices*, a communication which I have received from Prof. Smyth, containing a description of the great equatoreally mounted Refractor, of 11 inches aperture, erected a few years since by J. W. Grant, Esq., of Elchies, Morayshire; also some results of observations made by Prof. Smyth with the same instrument, on the occasion of a visit which he recently paid to Mr. Grant. It may be mentioned that the owner of this magnificent instrument resided many years in India, during which he employed much of the leisure time of an official life in cultivating scientific studies of various kinds, occupying himself occasionally with a 5-foot refractor of excellent quality. As an instance of what an observant eye may effect under favourable circumstances of climate, even although aided by an instrument of only inferior power, it may be stated that the duplicity of *Antares* was recognised by Mr. Grant as early as the 23d of July, 1844, that is to say, *two years anterior* to the discovery of the same interesting fact by the American astronomer, Prof. Mitchell, with the aid of the great Cincinnati Refractor (*Monthly Notices*, vol. xvi. p. 56). Prof. Smyth was recently led to a knowledge of this circumstance by an exami-

nation of Mr. Grant's observation papers. That it was not communicated earlier to the world is accounted for by Mr. Grant's retiring disposition, and by the modest estimation which he has invariably formed of his scientific labours. Prof. Smyth purposes communicating to the Society, on an early occasion, an account of Mr. Grant's astronomical observations in India.

Upon his return to Scotland, about twelve years ago, with the intention of spending the remainder of his life on his patrimonial estate, Mr. Grant resolved to continue his astronomical observations; and with a view to this object, he erected at Elchies* a substantial Observatory, which he fitted up with the great Equatoreal of 11 inches aperture, to which I have already referred. This was the first equatoreally mounted Refractor of considerable magnitude which had hitherto been erected in Scotland: indeed, with the exception of the Equatoreal of nine inches aperture subsequently acquired by the late Sir William Keith Murray, it is the only instrument of the kind deserving of the name which has ever been mounted in the northern part of this island. The unsuitableness of the climate of Elchies for astronomical observations, and recently continued ill-health, have prevented Mr. Grant from availing himself so fully of the advantages of this noble instrument as his Indian experience entitled him to hope for, and as the munificent sacrifice made by him in the cause of science so well merited.

At Prof. Smyth's request I have appended one or two footnotes to his communication, as, from the circumstance of his present temporary residence in the country, his access to original authorities has been necessarily limited.

Observatory, Glasgow, October 13*th*, 1862.

Experiences with the Elchies Equatoreally mounted Refractor of 11 inches aperture, in September 1862. By Prof. C. Piazzi Smyth, Astronomer Royal for Scotland.

Description of the Instrument.

This is a very remarkable instrument, as well in its mechanical as its optical portions, and I have had an unusual opportunity of becoming practically acquainted with both, during a continued stay of three weeks; for the whole of which time the key of the Observatory, and complete control over,

* Prof. Grant informs me that Elchies is situate about eight miles below the junction of the Spey and the Avon.—Ed.

and employment of, everything therein, were kindly conceded to me by the owner, and with the frequently repeated instructions that I was to employ them as freely as if the entire Observatory had been my own property.

From long remaining unused, a good deal of dust and thickened oil had to be removed before beginning work; but, that once done, all the essentials of the instrument were found in excellent condition, and micrometer observations of double stars were from that time made every fine night, and with a great feeling of satisfaction in the use and working of the instrument.

Optical Parts.

The object-glass is 11 inches in diameter and 16 feet in focal length. It has a number of minute bubbles in it (as indeed almost every object-glass has, and without further detriment than merely the loss of as much light as they intercept); but I have not been able to see any trace of striæ or positive imperfections in the glass, either by looking at or through it; or, by examining the discs of stellar light, by viewing a bright star, *α Lyræ*, much out of focus, and with a magnifying power of 397.

This power has been employed in all the observations, and with it, notwithstanding the very untoward state of the weather, some excellent proofs have been obtained of both the light-transmitting and the defining powers of the object-glass; though it is believed that better proofs still might be obtained, if a fully good night were to occur, and more difficult test objects to be above the horizon. The results, however, as far as yet secured, may be stated thus:—

In the course of examining a list of twenty-five well-known double stars, there were six cases where one or more additional small stars, not previously known or recorded, were discovered; besides two or three cases where small stars, whose existence had merely been mentioned by other observers, were found bright enough to admit of micrometer measurement in the Elchies telescope, with a position and distance wire micrometer and lamp-illuminated field.

These instances, of which a special list will be appended, and which speak chiefly for the light-transmitting power of the object-glass, were attained, even in spite of such bad definition of the atmosphere, that every star was more or less blurred and nebulous. There have indeed been only two occasions, and then only for a few minutes each time, when the atmosphere quieted and allowed the defining power of the object-glass itself to be studied; the first of these instances was on Sept. 17th, at 1^{h} P.M., when the Pole star was in the field, and looked a minute and brilliant disk with well-shaped thin rings around it, in the bright sunshine; the second was on Sept. 20th, at

5^h 30^m A.M., when B of γ *Andromedæ* was distinctly seen as two different and completely separated stars, which were measured accordingly both in position and distance. While that it was a triumph to the object-glass to see them in that manner, I may mention that the disk of each star was considerably less than the diameter of the fine spider's thread of the micrometer, and about 0·3, or 0·4 of a second of space in diameter; the distance apart, from centre to centre, being about 0·6 of a second.

In completion of the optical details it may be mentioned, that there are twenty-three eye-pieces of various powers, in addition to the two of the micrometer; twenty-four caps with coloured glass, several piles of coloured glass disks, screwing into each other, a fine totally reflecting prism of very large size, a dynameter, &c., in two mahogany cases; besides the position wire micrometer in its own box. The telescope has three finders, one of them being a fine 5-foot telescope, and is furnished with an illuminating apparatus for use with the micrometer.

Mechanical Parts.

The Equatoreal Motion.

The mounting of the Elchies telescope is on the principle known as the German, in contradistinction to the English, or the form with a long polar axis, and the telescope in the middle between the bearings.

The German form, viz., with short polar axis and telescope outside both bearings, is perhaps more frequently employed in every country than the other, and specimens of it in connexion with large telescopes are now numerous; but nowhere over the whole world has so firm, and solid, and well-constructed an example ever been mounted as that of Elchies.

This is saying a great deal, especially in knowledge of the admirable models sent forth to various public and private Observatories by the astronomical factories of Munich, Paris, and York; but I believe it to be perfectly true, and owing, greatly, to the late Mr. A. Ross, the optician of the telescope, having secured the services of Messrs. Ransome and May, Engineers, Ipswich, for the mounting. Messrs. Ransome and May were the firm who had been already selected and employed by the Astronomer Royal, to introduce into the new Greenwich instruments the solidity and improved methods of modern engineering; and I know that they entered with great zeal into the efficient carrying out of Mr. Ross's order, Mr. May himself personally assuring me, that he believed this instrument would be the beginning of a new era in the construction of Equatoreals, by reason of the astonishing firmness and steadiness, combined with truth, which he expected the mass of metal introduced into this one, and duly turned and planed, would impart to its

movements. It was this mounting, accordingly, which attracted such general attention and commendation in the centre of the nave of the British portion of the International Exhibition in 1851, and it commends itself equally now, after eleven years standing in an Observatory.

The declination and polar axes, each about 6 inches in diameter, in solid metal, and 5 feet long, are wonders of strength in connexion with any optical instrument, and could never have been produced by any mere optician; while the gun-metal bearings, and gun-metal circles, together with the gearing and ungearing apparatus for the endless screws, is of a majesty of form, size, and substance, more like steam-engine, than ordinary telescope, fittings.

Both circles, 30 inches in diameter, are cast as disks of gun metal, without any perforations, about 1 inch thick, additionally strengthened towards the centreing, and furnished with rack edge and noble endless screws to work in them, of actually 2·1 inches in diameter; while their end-shake and wear in their bearings is corrected by the efficient method adopted in the shaft of a screw steamer; or, by having a long series of projecting flanges cut on the pivot, and working into a similar series of depressions in the gun-metal bearing.

It will thus be seen that this part of the entire instrument is quite worthy both of the engineering fame of Messrs. Ransome and May, and of their training for astronomical structures under George Biddell Airy; and to their work Mr. Ross has added various fine fittings, graduation on the circles very easily read, an excellent system of double Hooke's-joint handles, workable from the eye-piece of the telescope, and an efficient equatoreal driving clock.

The Stand.

The mere stand or pier for supporting the bearings of the above-mentioned equatoreal axes of motion, is also a noteworthy point about the Elchies instrument. It is of iron, and by Messrs. Ransome and May also; there are the usual adjustments for the bearings of the axes, and the general form is convenient; but the remarkable and unprecedented thing is the extraordinary amount of weight introduced into it, for the purpose of checking those minute tremors which usually disturb accurate vision in all of the ordinary forms of mountings of large telescopes; and which can only be thoroughly corrected by the absorbing effect of mass. One portion of the stand accordingly weighs no less than eleven tons, and is the greatest quantity of iron ever cast into a single piece for any astronomical instrument of any age or in any country.

In conclusion I have to add, that though the telescope be so large, and the mounting so heavy, and though I have never had experience in the use of so large a telescope before, yet I found

no difficulty in managing this one without any assistance, could point from star to star by their places on the circles, with as much rapidity as on many much smaller instruments; could bisect the stars on the micrometer wires so well, by merely using the Hooke's-joint handles from the circle-screws, as to dispense with a "slipping piece" for the micrometer; and, finally, have never yet seen the smallest trace of instrumental tremor.

Sept. 27, 1862.

Appendix of Results of Observations with the Elchies Telescope in 1862.

28 Aquilæ, Mean R.A. $19^h\ 13^m\ 14^s$, and Decl. + 12° 7′ 22″, Jan. 1, 1862.

Components.	Mags.	Colours.	Position.		Full Weight.	Distance.	Full Weight.
				° ′		″	
A	6·2	Yellowish			= 10·0		= 10·0
B	10·0	Purplish	A B	176 38	(w. 1·0)	60·44	(w. 0·6)
(New) C	17·0	Blueish	A C	102 25	(w. 0·4)	66·76	(w. 0·1)

Date of observation = 1862·72.

The magnitudes and colours in Admiral Smyth's "Cycle" for A and B are "6 and 10, and pale white and deep blue," and are not more different from the above than atmospheric effects might explain, especially as the Elchies Observations were taken during twilight and the influence of its warm colouring. For the position and distance of A and B, previous measures are not abundant; but, numerically, both the angles of position and the distances are consistent in indicating some physical changes. Thus,

	Position.	Distance.	Date.
	° ′	″	
S.	175 4	59·28	1825·04
Sm.	175 42 (w. 8)	59·8 (w. 5)	1831·42 *

The new star therefore, C, picked up by the superior

* This star is not, of course, inserted in Struve's great Catalogue, the distance of the components exceeding his prescribed limits; but it is included in a list (given in the *Mensuræ Micrometricæ*, pp. 317, 318) of objects measured with a small instrument in the years 1821–23. The results are,

Dist. 60″·01 Pos. angle 176°·9 Epoch 1822·19.—R. G.

optical power of Mr. Grant's telescope, may become an important member in the system for future observers.

δ Aquilæ, R.A. $19^h\ 18^m\ 31^s$, and Decl. + $2°\ 50'\ 25''$, Jan. 1, 1862.

Components.	Mags.	Colours.	Position.	Full Weight.	Distance.	Full Weight.
			°	′	″	
A	3·5	Faint yellow		= 10·0		= 10·0
B	16·0	Blueish	A B 275	35 (w. 0·3)	94·96	(w. 0·2)
C	14·0	Blueish	A C 114	15 (w. 0·3)	192·30	(w. 0·1)

Date of observation = 1862·74.

B was invisible to the Sheepshanks' 5-foot at Guajara, Teneriffe, in 1856; but C was just visible, and, in the total absence of B, and without any micrometrical measures, led to a suspicion of a slip of 180° in the Tables. Now, however, the Elchies telescope, with its greater space-penetrating power, shows B still existing nearly as detailed in the "Cycle," but reduced from the 12th mag. in 1833·62 to the 16th in 1862·74; and if it was of that small size in 1856, no wonder that the small Sheepshanks' telescope was unable to show it.

The changes from the "Cycle" position and distance, 259° 3′ (w. 1) and 96″·5 (w. 1) in 1833·62 are probably effects of proper motion, and for the most part of A; if so, and if B and C, which are on either side of A, be greatly more distant, as indeed their small magnitudes imply, it will be of the utmost importance that A should in future be measured from both of them, instead of from B alone.

128 Anseris, R.A. $19^h\ 20^m\ 26^s$, Decl. + $19°\ 37'\ 12''$, Jan. 1, 1862.

Components.	Mags.	Colour.	Position.		Distance.	
			°	′	″	
A	6·5	Orange				
B	13·0	Violet	A B 41	2 (w. 1·0)	22·53	(w. 0·3)
C	12·0	Blue	A C 319	55 (w. 1·0)	68·14	(w. 0·2)

Date of observation = 1862·71.

The existence of the star C was discovered with the Sheepshanks' 5-foot telescope, at Guajara, in Teneriffe, and would appear now to be an important point to observe in future in connexion with A and B; for the above measures, compared with

	Position.	Distance.	Date.
	° ′	″	
Σ	43 35	22·647	1829·40
and Sm.	44 48 (w. 3)	25·0 (w. 1)	1833·58

indicate an orbital movement not hitherto recognised.

The Sm. observation is indeed somewhat anomalous, but it

was taken with an unusual micrometer, and, because "illumination was precluded to so small an object as B," appeared in the Bedford telescope. In Mr. Grant's larger telescope, however, B was comparatively so bright that there was no difficulty in illuminating the field and employing the usual wire-micrometer.

β Cygni, R.A. $19^h\ 25^m\ 9^s$, Decl. + 27° 40′ 20″, Jan. 1, 1862.

Components.	Mags.	Colours.	Position.	Distance.
			° ′	″
A	3	Yellow		
B	7	Blueish-green	A B 55 28 (w. 2·0)	34·20 (w. 1·0)
(New) C	15·3	Blue	A C 340 2 (w. 1·0)	61·49 (w. 0·5)
(New) D	15	Blue	A D 33 45 (w. 0·5)	107·50 (w. 0·2)

Date of observation = 1862·72.

The above magnitudes and colours of A and B coincide closely with those in the "Cycle," or, "3 and 7, and topaz yellow and sapphire blue." The positions and distances show a slight discordance from the authorities quoted or given there; as thus:—

	Position.	Distance.	Date.
	° ′	″	
B	57 34	34·20	1755·00
H	54 52	34·83	1782·45
P	54 31	34·28	1800·00
Σ	54 30	34·29	1821·76
H and S	54 45	34·38	1822·98
D	55 32	34·51	1830·54
Sm.	55 24 (w. 5)	34·2 (w. 5)	1830·81
Sm.	55 36 (w. 9)	34·4 (w. 9)	1837·58

Perhaps the two new stars may assist in proving whether, as has been supposed, both A and B are affected by proper motion, and either one differently.

ζ Sagittæ, R.A. $19^h\ 42^m\ 52^s$, and Decl. + 18° 47′ 47″, Jan. 1, 1862.

Components.	Mags.	Colours.	Position.	Distance.
			° ′	″
A	5·2	Whitish		
B	9·7	Violet	A B 313 19 (w. 2·0)	8·58 (w. 1·0)
(New) C	15·0	Blue	A C 250 42 (w. 1·0)	70·73 (w. 0·5)

Date of observation = 1862·73.

The above magnitudes and colours again come near those of the "Cycle;" and the positions and distances confirm them

remarkably in a feature where they had differed materially from older authorities, the series running thus:—

	Position.	Distance.	Date.
	° ′	″	
♅	304 10	8·83	1781·88
Σ	309 30	8·77	1819·74
H and S	314 32	8·82	1823·69
H	318 26	9·81	1829·63
Sm.	313 24 (w. 7)	8·9 (w. 7)	1831·59
Sm.	312 18 (w. 9)	8·6 (w. 9)	1838·67

The reason of these differences, so much larger than ordinary errors of observation, is difficult to conjecture truly, and may imply a dark planet of large size accompanying one of the stars. The new star C, now shown to exist, is too far off in itself to explain such perturbations, but may prove a useful referring point for the future.

452 Cygni, R.A. $20^h\ 57^m\ 4^s$, and Decl. + 38° 58′ 0″, Jan. 1, 1862.

Components.	Mags.	Colours.	Position.	Distance.
			° ′	″
A	6	Reddish orange		
B	10	Greenish	A B 300 33 (w. 2·0)	19·22 (w. 0·5)
(New) C	13	Blueish	A C 86 53 (w. 1·0)	98·01 (w. 0·4)
D	15·5	Blueish	A D 138 54 (w. 1·0)	54·29 (w. 0·3)

Date of observation = 1862·73.

The stars A and B are here each one magnitude larger than in the "Cycle;" the colours are nearly the same; but the position and distance indicate rapid proper motion, being given as 297° 0′ (w. 3) and 17″·0 (w. 1) respectively, in 1832·87. Neither C nor D are measured there, but D is evidently alluded to as a star "of the 13th magnitude, *s f*, and sufficiently near to form with A and B a triple object:" a description which indicates a change of magnitude to have occurred since then.

1 Pegasi, R.A. $21^h\ 15^m\ 43^s$, and Decl. + 19° 12′ 56″, Jan. 1, 1862.

Components.	Mags.	Colours.	Position.	Distance.
			° ′	″
A	4·5	Yellowish		
B	9	Grey	A B 311 16 (w. 2·0)	36·76 (w. 0·5)
(New) C	14·5	Blue	A C 22 59 (w. 1·0)	80·03 (w. 0·3)

Date of observation = 1862·72.

The magnitudes and colours of A and B, as here detailed, are nearly conformable to those of the Cycle; while the angles

of position and distances accompanying raise their history from "indicating no notable change," in 1833, to exhibiting a regular, though slow, orbital movement in 1862; as thus:—

	Position.	Distance.	Date.
	° ′	″	
H	308 19	37·10	1780·69
S	310 11	36·86	1825·22
Sm.	310 48 (w. 8)	36·40 (w. 5)	1833·95

The new star C may or may not form a member of the system, of which the proper motion is so very large that there is much need for a heavenly milestone to measure its movements from.

312 Pegasi, R.A. $21^h 45^m 6^s$, and Decl. + 19° 10′ 53″, Jan. 1, 1862.

Components.		Mags.	Colours.	Position.		Distance.
					° ′	″
	A	7	Yellowish			
	B	15	Blueish	A B	92 28 (w. 1·0)	20·32 (w. 0·5)
(Rediscoverd)	C	17	Blueish	A C	323 34 (w. 0·5)	21·74 (w. 0·3)
(New)	D	15·5	Blueish	A D	193 48 (w. 0·4)	80·95 (w. 0·2)
(New)	E	17	Blueish	A E	355 52 (w. 0·2)	127·30 (?)
(New)	F	18	Blueish	A F	308 52 (w. 0·2)	106·10 (?)

Date of observation = 1862·74.

The stars A and B having been described as "in a barren field" when looked at with a good 6-inch object-glass, I turned the Elchies telescope to them, and immediately saw C also; but this star had been previously discovered by Sir John Herschel with his 20-foot reflecting telescope, as mentioned in the "Cycle." A little further attention, however, soon revealed the additional stars D, E, and F, which, as far as I yet know, are new.

The position and distance of A and B, given above, differ from those of the "Cycle" beyond the limits of error of observation, and merit attention therefore; the numbers being

Position.	Distance.	Date.
95°·0 (w. 1)	15″·0 (w. 1)	1838·66

Elchies new (?) R.A. $21^h 47^m 46^s$, and Decl. + 19° 2′ 53″ nearly, Jan. 1, 1862.

Components.	Mags.	Colours.	Position.		Distance.
				° ′	″
A	6·7	Yellow			
B	8·7	Lilac	A B	110 58 (w. 2·0)	22·26 (w. 1·0)

Date of observation = 1862·73.

This pair of stars was picked up accidentally, by its coming into the 5-foot finder of the Elchies grand telescope, when the star "312 *Pegasi*" had passed out, through the weights of the driving clock having run down. I have not yet met with any observations of this double star elsewhere; but my references at the present moment are limited, and it seems too bright and too conspicuous for contrasted colours to have escaped many previous observers.*

ψ' Piscium, R.A. $0^h\ 58^m\ 17^s$, and Decl. + $20^\circ\ 44'\ 1''$, Jan. 1, 1862.

Components.	Mags.	Colours.	Position.	Distance.
			° ′	″
A	5	Yellowish white		
B	5·5	Blueish white	A B 160 22 (w. 2·0)	30·17 (w. 2·0)
C	12·5	Blueish	A C 121 20 (w. 1·0)	97·33 (w. 1·0)

Date of observation = 1862·72.

The existence of C was noted in the "Cycle" as "a very small star following;" but it was not micrometrically observed.

The measures there recorded of A and B are considered "to show *fixity*:" but if the present determination can be trusted to within a very small quantity, an extremely slow orbital movement may rather be inferred; the whole of the previous measures standing thus:—

	Position.	Distance.	Date.
	° ′	″	
H	170 0	27·50	1779·83
H and S	161 2	30·34	1822·38
Sm.	160 24 (w. 8)	30·2 (w. 8)	1833·97

The mags. and colours, given in the "Cycle" as "both 5·5 mag., silvery white," indicate little relative change in these respects during the last twenty-eight years.

222 Arietis, R.A. $1^h\ 51^m\ 56^s$, and Decl. + $20^\circ\ 23'\ 14''$, Jan. 1, 1862.

Components.	Mags.	Colours.	Position.	Distance.
			° ′	″
A	0	0		
B	12	Blueish	A B (w. 1·0)	(w. 1·0)
C	12	Blueish	B C 169 15 (w. 0·5)	36·94 (w. 0·3)
D	7·5	Faint yellowish	B D 0 35 (w. 0·5)	180·44 (w. 0·3)

Date of observation = 1862·74.

The observation of this group gave me great trouble and

* This star appears to be identical with No. 2841 of Struve's great Catalogue (*Mensuræ Micrometricæ*, p. 188).—R. G.

perplexity, until at last, by successive trials, I became perfectly confident of freedom from clouds, and the absolute R.A. and D. in the field of the telescope, and then recognised that every member of the group was present, except its brightest and leading component; viz. A, which the "Cycle" puts down as of the 6th mag.; while B and C and D are entered of the 15th, 10th, and 9th respectively!

Since the year 1834, therefore, D has increased considerably, and B somewhat; while C has slightly decreased, and A gone out altogether, or at least so far as the great Elchies telescope can penetrate into space! Yet perhaps the most immediately important circumstance of the whole case for practical astronomers is, that it has been said of the group, "It forms an admirable test to try the light and distinctness of a telescope."

The "Cycle" positions and distances to compare with the above are,

	Position.	Distance.	Date.
	° ′	″	
A B	53 0 (w. 1)	2·5 (w. 1)	1834·99.
A C	165 0 (w. 2)	40·0 (w. 1)	1834·99.
A D	359 12 (w. 2)	165·0 (w. 2)	1834·99.

γ Andromedæ, R.A. $1^h\ 55^m\ 25^s$, and Decl. + 41° 40′ 3″, Jan. 1, 1862.

Components.	Mags.	Colours.	Position.	Distance.
			° ′	″
A	3·5	Orange yellow		
B	5·5	Blueish green	A B C 62 12 (w. 2·0)	9·73 (w. 0·3)
C	6·0	Blueish green	B C 116 23 (w. 1·0)	0·57 (w. 0·3)

Diameter of disk of B = 0″·37

" " C = 0·23

" " wire = 0·58

Date of observation = 1862·71.

The above observations were procured in the early morning, about sunrise, on one of the only two occasions during the week when I had the fortune to witness, for a few minutes each time, a cessation of those atmospheric disturbances on which the definition of stars seen in a good telescope so greatly depends. The disks of the two close stars were then completely and more than separated, and were so small as to be in diameter only about half the apparent thickness of the fine spider's line of the micrometer employed in the measures.

Concluding Notes on the Observations.

The preceding observations have been hastily arranged, while on the road, so as to represent at one view the results, generally of two and sometimes of three nights' observation of each object. In affixing *weights* to the observations, while following my Father's method, as explained in his "Cycle," and keeping to his upper limit of 10, I have been obliged to descend below his lower limit of 1, by using tenths. This was because the atmospheric perturbations of telescopic definition on the banks of the Spey were really so fearful, and at almost every observation, that, had it not been my first, and too probably my last, opportunity of looking into the Elchies telescope, and therewith examining some anomalous features noted when gazing at certain double stars on the Peak of Teneriffe in 1856, and which I have had no other opportunity of inquiring into, I should not have made any observations at all, but have waited for a more favourable condition of the atmosphere.

By assigning such small weights as I have done, I hope to avoid doing any harm by otherwise sending out inferior, to mix, uncorrected, with superior observations by other and abler hands; while, with some of the objects, the cosmical changes have been so rapid, or the powers of the telescope so transcendent, as to overbear the rudeness of my micrometer-measures, and to show some valuable additions to the many physical facts recorded in the "Cycle" up to its closing epoch. That book is the only one I have yet compared the observations with, and the only one I have with me on the journey; but I trust that I shall be allowed more honourable reasons also, for desiring to use it as a standard work of reference.

The value of the micrometer-screw in seconds of space has as yet only been approximately determined from the observations made for the purpose, and may, perhaps, require a small addition, as of about $\frac{1}{200}$ of the whole; but that present uncertainty on the distances alone, will not at all interfere with the character of the chief results now brought out, as affecting the discovery of new stars and changes in angle of position of old stars, or large variation in their distances.

Illumination of the field, and by red light, according to Sir John Herschel's discriminating suggestion, was always employed for the actual micrometer-measures; but the estimation of magnitudes and colours was always made in a darkened field.

Oban, October 7th, 1862.